Guidelines for Forestry Extension

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October 1988

ECONOMIC & REGIONAL DEVELOPMENT AGREEMENT

Canada

BC

Funding for this publication was provided by the Canada-British Columbia Forest Resource Development Agreement - a five year (1985-90) $300 million program cost-shared equally by the federal and provincial governments.

Canadian Cataloguing in Publication Data

Bunnell, Pille
Guidelines for forestry extension

(FRDA report, ISSN 0835-0752 ; 046)

Issued under Forest Resource Development Agreement.
Co-published by B.C. Ministry of Forests.
"Canada BC Economic & Regional Development Agreement."
Bilbliography: p.
ISBN 0-7726-0874-1

1. Forestry extension work. 2. Forest Management.
I. Canadian Forestry Service. II. British Columbia. Ministry of Forests. III. Forest Resource Development Agreement (Canada). IV. Canada BC Economic & Regional Development Agreement. V. Title. VI. Series.

SD251.B86 1988 634.9'0715 C88-092212-5

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Province of British Columbia

This is a joint publication of the Canadian Forestry Service and the British Columbia Ministry of Forests.

Produced and distributed by the Ministry of Forests, Research Branch.

For additional copies and or further information about the Canada-British Columbia Forest Resource Development Agreement, contact:

Canadian Forestry Service
Pacific Forestry Centre
506 West Burnside Road
Victoria, B.C. V8Z 1M5
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ACKNOWLEDGEMENTS

The author wishes to thank the many people who generously contributed their time and ideas in discussing the needs of Forestry Extension in British Columbia. These people expressed a strong commitment to the management of the forest resource. They are, in fact, our basic management resource.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS iii

1 INTRODUCTION 1

2 EXTENSION PROGRAMS 1

2.1 A Framework for Extension Programs 1

2.2 The Effect of Institutional Structure 2

2.3 Selected Examples of Extension Programs 3

2.3.1 The Forestry Commission of Great Britain 4
2.3.2 Southwest Oregon reforestation 4
2.3.3 Weyerhaeuser Company: Washington State 4
2.3.4 Transferring IPM technology 5
2.3.5 Maritime forestry issues 5
2.3.6 Integrated Forest Pest Management (South East U.S.) 5
2.3.7 Oregon State University Forestry Extension Services 6

2.4 General Characteristics of a Successful E&D Program 6

2.4.1 Personal contact 6
2.4.2 Personnel 6
2.4.3 User involvement 7
2.4.4 Documentation 7
2.4.5 Integration between researchers and users 7

3 EXTENSION METHODS 7

3.1 Principles of Learning 7

3.1.1 Language 8
3.1.2 Participation 8
3.1.3 Relationship to person presenting information 9
3.1.4 Design 9

3.2 Dissemination of Information 10

3.2.1 Stages in adoption 10
3.2.2 Characteristics of adopters 11
3.2.3 Characteristics of information 13

4 GUIDELINES FOR EXTENSION METHODS 14

4.1 Framework for Extension Vehicles 14

4.2 Communication Aids 15

4.3 Expertise 18

5 CONCLUSION 18

6 LITERATURE CITED 19

TABLES

1 Roles and expertise required in an extension program 18

FIGURES

1 An extension framework distinguishing the roles of research, development, extension and demonstration 2

2 The role of feedback and monitoring in integrating forestry practice and research within an extension framework 3

3 Extension vehicles need to be designed to provide familiarity, understanding, and application knowledge to facilitate the stages in diffusion of innovations 12

4 Distribution of individuals with respect to rate of adopting innovations 13

5 Framework for extension vehicles 15

6 Functional roles of communication aids 16

7 Communication aids suitable for documentation 17

8 Communication aids suitable for personal contact 17

1 INTRODUCTION

Understanding a resource is fundamental to its wise management.

Our culture has a well-established educational process designed to impart an understanding of resource systems to resource managers — including foresters. Education and training programs for foresters provide them with the knowledge and understanding required for their jobs. However, our understanding of natural resource dynamics is still incomplete. Although directed research and management experience are continually adding to the discipline, the existing education system caters mainly to new foresters — not to those in management positions. Thus, unless there is a system in place to ensure that new developments in resource use are made available to managers, management practice will only change slowly, as the new, comparatively inexperienced foresters introduce recent concepts. The factors affecting the forest resource (economic and social pressures, pollution, pests, and shifts in global climate) are currently changing so rapidly that we cannot assume the stance of responsible resource management unless we actively promote the use of the knowledge we gain. This means that we need a system in addition to the education of new foresters — a system to deliver new knowledge and understanding to practicing foresters. This system already exists, and is called Extension. What is now required is a focus on the extension process so that we can use this aspect of resource management more effectively.

This report provides guidelines for those individuals involved in the design and delivery of extension activities. It is divided into two main sections: one on extension programs and the other on extension methods. The first provides an overview of existing programs and extracts those elements that characterize a successful program. The second section is grounded in the principles of learning and in the processes of information dissemination. It presents guidelines for using methods to deliver extension activities. Throughout the report, where the information presented has implications for forestry extension, these are highlighted in the text.

The aim of this report is not to provide specific instructions on "how to do it, " but rather to illuminate the extension process so that those involved can better fulfil their roles and responsibilities. Although the report is written in the context of the Extension, Demonstration, Research and Development subprogram of the joint federal and provincial section of the Canada - British Columbia FRDA Backlog Reforestation Program, it is intended to be generally applicable to extension programs in other areas.

2 EXTENSION PROGRAMS

2.1 A Framework for Extension Programs

The old model of technology transfer in which researchers supply the answers to operators who simply use the answers has proven to be inadequate. According to Lawrence and Lembersky (1984), technology transfer "cannot be likened to osmosis, with new information flowing through an organization on a technology gradient to receptive minds scattered here and there in operations." The traditional definition of research also hinders this process. According to Gill (1985), research is "the investigation process that tests for predictability through observation and experimentation." As such, it is fundamentally a knowledge-generating process, not a problem-solving process (Gill 1985).

Extension and demonstration programs are generally seen as mechanisms to transfer theoretical and practical knowledge to the practicing forester. An extension program is intended to assemble and integrate theoretical and practical knowledge; and to present it so that it can be readily applied to management.

Figure 1 distinguishes the elements of this process, notably the stages of technology transfer: research, development and application (Ellis 1986). Research, as a process, generates theoretical knowledge about the biophysical system. The process of development combines theoretical knowledge with a general understanding of the institutional and biophysical systems to produce practical knowledge. The practical knowledge and recommended treatments and actions, together with some basic theoretical knowledge, are passed on through the extension and demonstration program to the practicing forester. The forester modifies this practical knowledge with his personal experience of both the biophysical and

institutional systems at the local level, generating the actual applications. These applications affect the biophysical system.

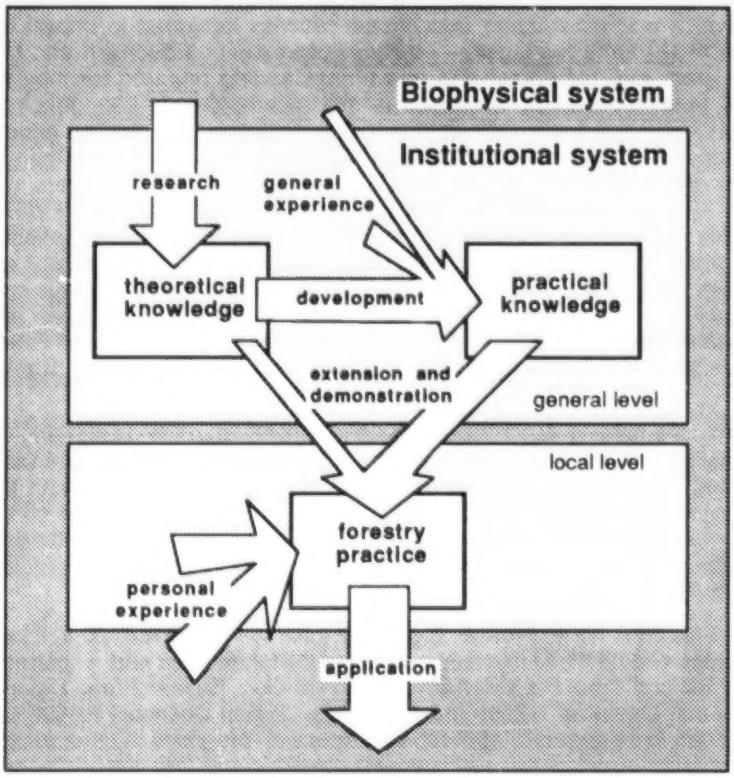

FIGURE 1. An extension framework distinguishing the roles of research, development, extension and demonstration.

A weakness often found in the process of developing applications from research is that there is no feedback from the practicing foresters' experience of the application, to the underlying research or the development of the practical knowledge. This potential feedback link is shown in Figure 2. With this link, the extension and demonstration program may be viewed not simply as a program to transfer knowledge from the researcher to the practitioner, but rather as an explicit process to ensure there is dialogue between the two.

2.2 The Effect of Institutional Structure

An "institutional system" is really a mosaic of many overlapping institutional structures, each having its own purpose. Individuals within these structures are rewarded and compensated for a variety of different objectives (Macon *et al.* 1970). Any extension and demonstration program must recognize these institutional differences if it is to become effective.

For example, researchers are generally rewarded for their contribution to research, which is measured almost exclusively by the number of articles they have had published in refereed journals (Gjerstad and Glover 1987). Thus, the researcher is motivated to do research that he can rigorously defend. The manager, however, is interested in expeditious results that are likely to do a reasonable job. The nature of the underlying reward structure exerts a bias on the type of work that is done.

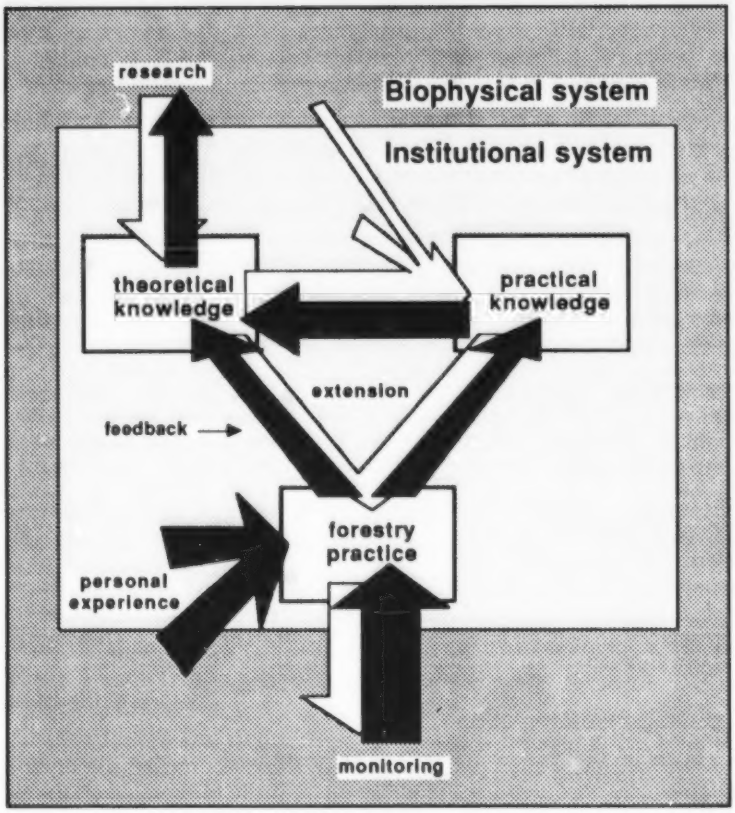

FIGURE 2. The role of feedback and monitoring in integrating forestry practice and research within an extension framework.

Institutional structures have the capacity either to limit or to enhance the effectiveness of an extension and demonstration program. They may affect the processes of integration between researcher and user, the processes of information dissemination, and the incentives for learning.

Institutional structures are slow to change, with a tendency to generate a self-maintaining infrastructure — as if they had a life of their own (Holling 1982). Therefore, the design of an extension strategy should recognize the current institutional structures and organizations, and capitalize on existing activities. The strategy should be to modify the existing programs so as to create a working forum for dialogue and change. This "subversive" activity is more effective if it is implemented by an administrative organization, which can add rewards and incentives to the current institutional structures. As Macon (1967) noted, "research and management men will both be involved, but the real repairs must be made by administration."

Implication

Because the FRDA extension program has a short time framework, it should be developed to provide suitable rewards within the existing institutional structure.

2.3 Selected Examples of Extension Programs

Case histories provide examples of what approaches work in extension programs, and what do not under various circumstances. Where we observe similar program elements succeeding in different

settings, we can extract general principles. Where we observe differences, we can look for specific cultural and institutional requirements.

2.3.1 The Forestry Commission of Great Britain

The Forestry Commission of Great Britain recognizes the inherent difficulties in communicating research results to forest managers in the field. In an attempt to overcome some of these difficulties, special programs and policies were put in place (Blatchford 1971; Holmes 1984). These measures encourage communication between field and research staff and facilitate the application of research results.

Close connections with both field and research personnel are maintained through regular visits by senior and junior researchers to regional senior and junior field personnel. In addition, there is considerable staff interchange between research and field personnel. As a consequence, forest managers get involved in selecting applied research projects and priorities.

Seminars and appreciation courses are held annually for field staff. In these sessions, personal contact is made, encouraging participation and the exchange of ideas. Field courses for forest workers are taught by specially trained extension personnel, not the researchers, although there is close collaboration between the two groups.

Particular attention is paid to the format of publications so that users will receive the information in the most appropriate form. At present, short operational guides are published for managers, supported by more detailed research results. Summaries of research are also published in annual reports. To disseminate information further, a Research Information Section, located at principal research centres, is responsible for maintaining and improving contact with researchers within and outside the Commission, as well as answering inquiries from field staff. This section, however, is not a separate extension service.

2.3.2 Southwest Oregon reforestation

In Southwest Oregon, initial attempts at technology transfer programs concerned with reforestation problems failed. Basically, they were not of sufficient intensity to produce changes in existing forestry techniques. A more intensive program (Forestry Intensified Research, or FIR) was started in 1977 and has met with more success (Hobbs 1984).

This program began with an interdisciplinary team of forestry specialists (knowledgeable in both research and operations) holding problem analysis workshops with foresters at the regional level. At these meetings, participants identified problems and established research priorities. Some research needs were met by a concurrent program of fundamental research, but most were met by the adaptive program in which available research results were applied to local conditions through field-oriented studies. The results of this research were readily translated into operational changes. An important component was to involve individuals who were able to influence others from within co-operating organizations. "Adaptive research conducted locally, with the cooperation of group opinion leaders, has a high degree of credibility" (Hobbs 1984:71).

Another feature of this program was having specialists – not researchers – co-ordinate and present information diffusion programs. These programs relied both on publications (such as a quarterly newsletter) to stimulate interest, and on personal contacts through office and field visits, to give specific information.

2.3.3 Weyerhaeuser Company: Washington State

Weyerhaeuser's experience in Washington State is similar to that of Oregon State, discussed above. Weyerhaeuser also focussed on using field stations as the means for transferring research results to staff at the operations level (Lawrence and Lembersky 1984). Personnel at the field station were dedicated specifically to the task of technology transfer. Their responsibilities included advocating new technology, conducting site-specific research to meet regional operational needs, and supporting R&D projects at the field level. They were selected especially for their skills at integrating research results and their ability to work with people in learning situations.

Demonstration projects carried out at the field stations were carefully planned to illustrate how and when the new technology is best used. The involvement of operations personnel in these demonstrations helped to give these people a sense of "ownership" in the new technology, thereby increasing the likelihood of its implementation. "This approach educates both researcher and practitioner in what is necessary to fine-tune the technology to better serve operational needs" (Lawrence and Lembersky 1984: 82).

2.3.4 Transferring IPM technology

Stark (1984) was involved in the development of two different integrated pest management (IPM) programs. The contrast between the two provides several observations relevant to extension program design. One of the "keys to success" of accepting new research from the Canada/United States Spruce Budworm Program (CANUSA) (located at the Pacific Northwest Forestry and Range Experiment Station) was having personnel dedicated to the task of technology transfer. In addition to having an application co-ordinator, five regional support personnel were appointed to implement current research and maintain regular contact with forest managers. The CANUSA program also benefited from the work of two information specialists who helped produce publications tailored to the needs of users.

A 5-year program of IPM for bark beetles in pine forests, sponsored by the National Science Foundation/Environmental Protection Agency (NSF/EPA), was much less successful than the CANUSA program for several reasons. First, an overall technology transfer program was not planned, and therefore the program remained primarily a research program. Second, the users of the research were not involved at the beginning of the program when goals were established and the research program was designed. As a consequence, the research was not widely accepted. Third, research results were largely published in scientific journals. Field personnel seldom consult these journals because they consider both the content and language to be irrelevant to their needs.

2.3.5 Maritime forestry issues

Two recent programs of technology transfer in Canada's Maritimes (one for controlling spruce budworm and the other for improving Christmas tree productivity) illustrate two important points (Embree 1984).

First, when managers and research personnel work together, the managers (or users) accept the technology more readily than if the technology is presented *fait accompli* to the users. As seen in the joint development of a computer simulation model to contrast the effects of a proposed budworm control program with current forestry practices, the managers could see for themselves why the proposed technology was more advantageous to use.

Second, when researchers and users do not agree on research goals, the results of the research is rarely accepted by users. Again, the value of personal contact in the early stages, to help the two groups understand each other's needs, is necessary for successful transfer.

2.3.6 Integrated Forest Pest Management (South East U.S.)

The epidemic status of the southern pine beetle in the early 1970's provided the initiative for a 5-year research and application program begun in 1975. Technology transfer plans were included in the original design of this program. These included newsletters, user involvement in the planning and execution of research and development, involvement of researchers in the technology transfer, and the preparation, packaging, and delivery of written and visual materials to user groups. Hands-on experience with computerized information management and decision support systems was also provided. Projects to demonstrate improved technologies and "best management practices" were found to be a very effective means of transferring new information. These provided a means for the users to observe and discover the application of new technology on their own land and within their own objectives and conditions.

Evaluation of the process, the products, and the consequences of the transfer efforts was ongoing. The program benefited enormously through the use of an established communication network which included both state and national forestry staffs, as well as extension specialists.

2.3.7 Oregon State University Forestry Extension Services

Currently, Oregon State University has a reputation for having one of the best forestry extension programs in North America. This program has evolved over several decades. It began where many other universities now find themselves: with faculty offering extra courses from their personal time (Oregon State University 1981).

An extension position was first created in 1944, and began by addressing small land owners and 4-H forestry clubs. Initially, county agents without any forestry education were used as a network for disseminating information with the users. Through their personal contact with both researchers and users, they served as the interface between the two groups.

Further evolution of the program was patterned on the approaches used by agriculture extension at Oregon State University. The concept of using two types of personnel – field agents and extension specialists – was implemented by 1975. Forestry-educated (M.S. degree) field agents are responsible for the development and delivery of local forestry education programs, including a local newsletter. The field agents are located in county offices. Extension specialists work in the School of Forestry. They provide a link to the researchers, develop and deliver educational programs throughout the state, and provide assistance to the county agents. By 1981, extension staffing had expanded to 11 forestry agents and 7 specialists. Together they now have over 40 000 personal contacts per year with their user communities.

Today, extension and development activities are on near-equal footing with teaching and research at the university. Current programs range from highly technical to the "how-to" variety. Most training sessions and workshops are 2-5 days in duration. Indepth training is offered through Forest Engineering and the Silviculture Institute. The list of publications, slide-tapes, courses, workshops, and conferences is too long to enumerate here.

The success of the program can be attributed in part to its structure, which ensures continuing feedback between the user and researcher, and which provides the required expertise in the right places. As explained by the current chairman of marketing of Oregon State's Extension Services, Dr. Ken Kingsley (pers. comm.), the program evolves through bargaining sessions between the extension specialists who represent what information should be disseminated, and the field agents who represent what information is needed. These groups meet bi-annually to plan the four to five major and several minor projects to be completed in the next cycle. Once the projects are selected, the extension specialists, aided by a production staff, produce the materials (written and visual) required for delivery. Delivery occurs via the communication network in which the field agents play a central role. Field agents may use the extension material on their own, or may call in the specialists as needed.

2.4 General Characteristics of a Successful E&D Program

2.4.1 Personal contact

Perhaps the most important component of a successful technology transfer program is personal contact (Macon 1967; Blatchford 1971; ESSA 1982; Callaham 1984). Personal contact between researchers and operations people leads to a better understanding of each other's relative positions. In any training session, meeting, or workshop, it encourages each participant in the exchange to be involved and thus to contribute to understanding and practice. It also speeds the process of matching theoretical knowledge to practical implementation. Personal contact reduces jargon, cutting through the barriers between disciplines, and, most importantly, encourages trust, thus leading to co-operation.

2.4.2 Personnel

It is imperative that adequate manpower be available for the personal contact mentioned above. In many programs, personnel are specifically dedicated to providing a link between researchers and operational foresters (Macon 1967; Macon *et al.* 1970; Callaham 1984). Ideally, these people are integrative thinkers and have experience in both research and forestry management (Callaham 1984). They interpret the research results for field people, suggesting the best format for presentation. They can also be available for carrying out demonstrations of new techniques, and for answering questions from field staff.

2.4.3 User Involvement

User involvement has been achieved through demonstration and participation. Participation that includes time for hands-on experience increases learning success (Blatchford 1971). Demonstrations allow people to judge for themselves the validity of new options (Callaham 1984), an objective difficult to achieve by any other means. "Case study" or demonstration projects have been particularly successful, as they provide for both participation and a demonstration of results. The joint development of a computer model in the case of controlling spruce budworm in the Maritimes is an example of a demonstration project.

2.4.4 Documentation

Most programs have recognized that although research results are regularly published in journals, conference proceedings, and annual reports, they are rarely in a form usable by silviculturists or field staff. These people are also often faced with time constraints and geographic isolation, which may hinder their access to the traditional sources of research information. Results need to be interpreted so the users can see the relevance of the research to their problems. In Great Britain and at Oregon State University, audio-visual aids and short handbooks on specific topics are produced for the users.

2.4.5 Integration between researchers and users

When technology transfer programs are not successful, the root cause is often lack of integration between researchers and users. The partial failure of the Christmas tree program in the Maritimes is one example. The information flow from users to researchers is often missing, yet it is the most critical part of the process. If the intended users of the research do not perceive a need for the "improvement," then there is little chance of the technology transfer succeeding. Various means, such as co-operative research programs, can be used to bridge this gap. In the Oregon State University extension program, the field officer - extension specialist combination effectively bridges the activities of researchers and users.

3 EXTENSION METHODS

Extension and demonstration programs are generally seen as mechanisms to transfer theoretical and practical knowledge to the practicing forester. This involves two processes: education or learning of new knowledge by the user, and dissemination of that knowledge to the user. A brief review of what is known about those two processes is presented here.

The word "information" is used with a specific bias in this report. It is not intended to connote "data" but rather "intelligence," the distinction lying in the usefulness of the information. The same bits of information could be either data or intelligence, depending on the ability of the user to understand the relevance of the information. Knowledge is the cumulation of information, specifically information that is understood and used within a particular framework.

3.1 Principles of Learning

Because learning is inherent in being human, it is generally taken for granted: it will occur, and it will be done right. However, a number of assumptions are made that are irrational and even counterproductive.

Most people assume that the way to teach is the way they were taught; that is, the way it is usually done is the successful way. However, the design and evaluation process that has led to traditional classroom teaching is limited, and a generation out of step with current values and understanding.

Another assumption is that covering the information communicates the information. Making a statement in a training program or mailing a publication is often taken as completion of learning; – and, if no questions or other response ensues, understanding is assumed. Furthermore, a pleased reaction to the document or training session is taken as clear evidence of successful learning – sometimes a confusion of entertainment and effectiveness.

A third assumption is of a linear relationship between the investment made in teaching (e.g., production of a costly videotape) and the effectiveness of the result. This assumption is not simply made by people attempting to measure the extent of a program. It results from the inherent difficulty of measuring the effectiveness of learning when the results can only be seen over a long time horizon and a broad geographical scale.

Fortunately, there is a body of knowledge and experience which can contribute to the design of effective learning. Some observations relevant to the design of a forestry extension program are outlined in the following sections.

3.1.1 Language

If a foreign language is spoken, not everyone is expected to understand. However, if jargon is spoken, the speaker is usually blind to the fact that this "dialect" may be incomprehensible, or worse, misinterpreted. It is fundamental that the language used either in teaching or in publications be the language of the learner.

Metaphors, similes, and examples form a "meta-language" that can be very effective. These, too, should be chosen from the domain of experience of the learner.

Implication

Persons responsible for writing reports or delivering training sessions to field foresters should be fluent in the language and experience of this group.

Not all people think the same way. Some are linear, logical thinkers; others are more holistic. Some are verbally proficient; others deal well with analytic concerns and numerical interpretations; others operate with mental pictures of examples and relationships. Still others relate well to motor patterns and physical experience. Furthermore, any one task can call into play a number of these modalities for any one person. Recent work in neuropsychology substantiates the neurological basis for these differences, popularly simplified as left/right brain distinctions (Springer and Deutsch 1981).

Evidence also indicates that use of several modes of thought or perception can substantially increase understanding. For example, research conducted by the U.S. Navy with the learning of recruits indicates that a spoken lecture generally results in 10% retention of information. The addition of key-word visuals (outlines, important points, etc.) doubled the rate of retention to 20%. These both relate to the same mode: verbal. If another mode, visual, was added through diagrams and other illustrations, learning increased to 60%. Interestingly, the visual material alone was equally effective as the verbal alone, with a 10% retention (Practical Management Associates 1980).

Implication

Documents should include extensive illustration in the form of graphics, diagrams, and photographs. Training sessions should be liberally enriched with illustrations further to traditional point form or keyword visuals.

3.1.2 Participation

People learn in "active mode, " by being involved intellectually or physically. This means evaluating and fitting new information into existing knowledge and experience, and trying it out. The reader of a document can do this silently on his own, or involve his peers in a discussion. The choice of whether to engage actively is up to the reader. In a training session, the passive listener mode can be avoided by structuring discussions and exercises that enable the learner to apply the new information.

An easily repeatable group exercise demonstrates the role of feedback in a presentation (Pfeiffer and Jones 1969). When feedback is incorporated into a presentation, both task performance and self-evaluation improve in accuracy by about 50%, but the presentation takes twice as long.

Implication

Training sessions should include participative exercises and "hands-on" activities. The trainer should be competent in leading group exercises.

Group size limits participation. As the size of a group increases, the proportion of time taken by the less aggressive members decreases disproportionately. An ideal group size for generating ideas, interaction, and discussion is about seven to eight people. The prestigious Dahlem conferences held on various scientific concerns in West Germany state 12 as the absolute maximum (Miller 1987) to "allow participants to form opinions rather than just give them."

Implication

The number of participants in a training session should be limited to 8-12 people. Larger sessions are possible if effective group size is kept low through a substantial use of subgroups. Instructorless subgroups have limited utility, therefore, multiple instructors may be needed for larger trainings.

3.1.3 Relationship to person presenting information

The information presenter can assume a number of stances with respect to his audience. He can be act as an expert, speaking to those who are less informed; or as an informant whose job is to provide a service to the audience. He can be arrogant or humble, distant or accessible; he can be caught in his own opinions or open to those of his audience. The relationship established with the audience affects the efficacy of the learning process, and it does this in a culture-specific way. In a culture where tradition is important, and distinctions between right and wrong are crisp, an authoritarian presentation can be effective. In a culture that values personal innovation and tolerates ambiguity, any presentation that hints at a lack of or respect for the values and ideas of the audience is destined to be ineffective.

A presenter who demonstrates enthusiasm for the subject area will kindle the enthusiasm of the group. This does not imply "hype" – people are experts in detecting insincerity – but rather a true commitment to the topic and to the process.

The credibility of the person presenting information influences how seriously he is listened to. In part, this is established by his reputation within the audience (not necessarily his reputation with other groups); and in part by his demonstrated knowledge in the subject area in question. If the presenter knows only the course syllabus, and is not able to answer related questions or interpret how the information relates to local concerns, his credibility suffers. If the personal experience of the learner conflicts with what is being presented, it is the personal experience which will be trusted. The credibility of the person delivering the information will be in jeopardy, and he is not likely to know about it.

Implication

Where trainers are responsible for eliciting learning, it is extremely important that they have a suitable personality and good knowledge of the relevant subject area.

3.1.4 Design

The design of a publication, and especially a training program, has enormous consequence on its effectiveness. There are several factors that influence success:

- Relevance

  For the reader or trainer to engage in the information, it must be clearly relevant to their needs and interests. The question of "what's in it for me" needs to be addressed early.

- Clarity of organization

  The learner should know what to look for, and what is expected of him; expectations should be clearly identified at the beginning. Thereafter, a logical, simple, and clear organization should be followed and referred to. This implies good structural design of a report outline or lesson plans, and the structure be obvious to the learner.

• Understandability

Information that is not readily understood is not easily learned. Usually it is necessary to edit information so that only essential elements are included; it is better to present a few things which will be understood, than a large number which will not be absorbed. Skill is required to "untangle" complex ideas and present them in a simple form.

• Interest

People remember ideas that relate to their existing interests or that are in some way vivid. Stories, demonstrations, visuals, and packaging with respect to audience interest encourage retention. However, it is important that the vivid material relate to the content of the presentation, or the learner may remember only the jokes that were told.

• Learner materials

Repetition is a key element in learning. (This has in part to do with the biochemistry of transferring short-term memory to long term memory.) Publications can be re-read, thus enabling repetition. Repetition can be built into a training session, but this should be done discretely so the learners do not feel they are being treated as juveniles. Provision of clear, concise, take-home materials, which may include course workbooks or topic summaries, enables the learner to refer repeatedly to the material until it is fully absorbed. This material also facilitates sharing information with other users, which further crystallizes the content in the learner's mind.

Implication

People with an understanding of the learning process and with skills in developing training materials should be used in the design stage of training development.

3.2 Dissemination of Information

Information is disseminated through a social system. When new information is introduced, its spread or dissemination can be traced through the system. This process, called "diffusion of innovations" in the literature, is the subject of thousands of reports, and has become a rapidly growing field of study (Rogers 1983). These studies are largely concerned with technological innovations which have both hardware and software components. Some potential elements of a forestry extension program represent technological innovations (e.g., computerized information systems, and new equipment for site preparation), but others represent basic information that is being requested by the user. However, the dynamics of the education process have some characteristics in common with the process of innovation diffusion, so it is clearly worth considering this body of knowledge in designing an extension program.

3.2.1 Stages in adoption

As pointed out by Muth and Hendee (1980), there are several stages between the development of new information and application of that information. Initial awareness needs to be followed by evaluation, ownership (or internalization), and the fitting or adapting of the information to the local situation. Each of these stages uses a different product.

Although terminology varies, social scientists recognize several stages between the production of information and action:

• Acceptance

Before anyone will let awareness of a new idea penetrate, there has to be a condition of acceptance; that is, the individual should not feel the need to be defensive about his current ideas or practices.

Implication

Researchers and trainers who interact with the user must understand and respect the user, for the latter to be receptive to new ideas coming from these sources.

• Awareness

Awareness and interest come from exposure to various communication networks (including newsletters) and from conversations. Characteristics of both the information and the user determine whether and how fast interest develops. This is discussed below.

Implication

The extension program should include vehicles that encourage familiarity with various types of knowledge which may be pertinent to the system. Activities that encourage communication networks (such as meetings to provide time for informal exchange) will increase the effectiveness of the diffusion process.

• Evaluation

Evaluation begins with mental considerations: weighing of the pros and cons, the complexity, the trialability, and other considerations. In effect the individual is asking, "Can I and should I?" Personal contacts with trusted individuals and the advice of opinion-makers are particularly important at this stage.

Implication

Vehicles that promote understanding are especially important in allowing users to evaluate the new information. These include summary publications that relate the new knowledge to user concerns, training sessions, and demonstration projects. Activities that encourage communication networks are also relevant to this stage, and materials that can be readily shared by colleagues (e.g., take-home materials from training sessions) enhance the evaluation process.

• Ownership

At some stage during evaluation the individual goes through a subtle change and "owns" the idea. This is important: a successful application cannot be made until the user "owns" the idea, and, once he makes this transition, he becomes responsible for interpretation. At this point, the originator has no more control; it is no longer "his" idea.

Implication

Extension vehicles that provide applied information as well as understanding are required for users to acquire ownership of a new idea or innovation.

• Fitting

Once the innovation is owned by the user, it will be fitted to his specific requirements. It will be modified and integrated with previous understanding. Constraints on resources, administrative demands, and personal preferences will influence the fitting process. In the literature on diffusion this process is also called "reinvention, " and is sometimes perceived negatively as the changes transform the "pure" invention.

Implication

User experience is the prime force controlling this process. At this stage the extension program has negligible effect. The quality of understanding supplied during earlier stages will determine the effectiveness of the fitting procedure.

An extension program needs a spectrum of extension vehicles to provide for familiarity, understanding, and application (Figure 3). The institutional structure and the attitudes of people involved in the extension program affect all stages, but are critical in the acceptance stage. By the fitting stage, the experience of the user has the largest influence.

3.2.2 Characteristics of adopters

Different individuals adopt change at varying rates. In any user population there is a distribution of people who have different rates of adoption (Figure 3). Those who are highly experimental are termed "innovators" in the literature (Rogers 1983) and are not always given high credibility ratings by their

peers. New ideas are also incorporated rapidly by the "early adopters," followed by the "early majority," who can be characterized as respectable and deliberate. The skeptics eventually follow as the "late majority," and a few die-hard or traditional individuals lag at the tail of the distribution.

Each group of users is familiarized with the innovation through a mixture of external media and internal communication networks. The external media are particularly significant for the early adopters, whereas the later adopters rely more heavily on the opinions and experience of their peers.

Within the user community there are individuals known as opinion leaders. These are highly respected people, and may derive from either early or late adopters depending on whether the cultural norm encourages change or values tradition. Opinion leaders are generally more cosmopolitan than other users, and have more access to external communication channels and a higher rate of social participation. They are often located at major linkages in communication networks.

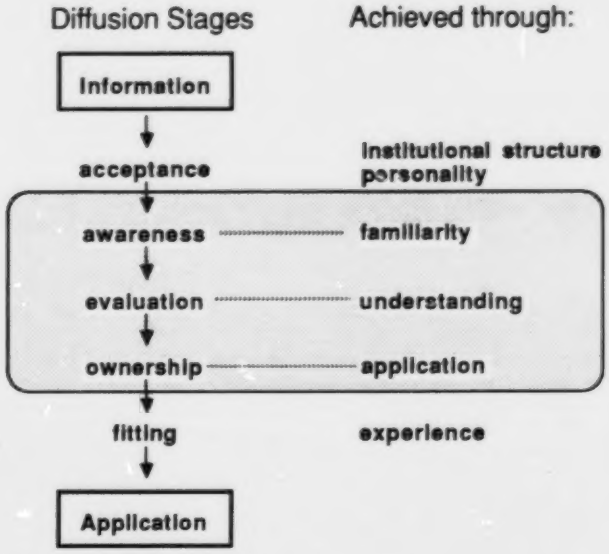

FIGURE 3. Extension vehicles need to be designed to provide familiarity, understanding, and application knowledge to facilitate the stages in diffusion of innovations.

A survey of extension users in British Columbia (Bunnell and Pearce 1988) indicates that diffusion currently proceeds via institutional pathways to the regional and district offices, and that communication networks exist between people at these levels. Communication networks at the field staff level are largely limited to within one district. Consequently, diffusion is patchy by districts, being implemented first in those where the district officers are early adopters. Field staff in districts where district officers are late adopters have minimal awareness of the innovation.

Implication

Activities that will increase contact between field foresters will encourage the rate of diffusion of new knowledge. Programs designed to further the understanding of regional and district managers will promote their acceptance of the innovation and their likelihood of communicating it to their field staff.

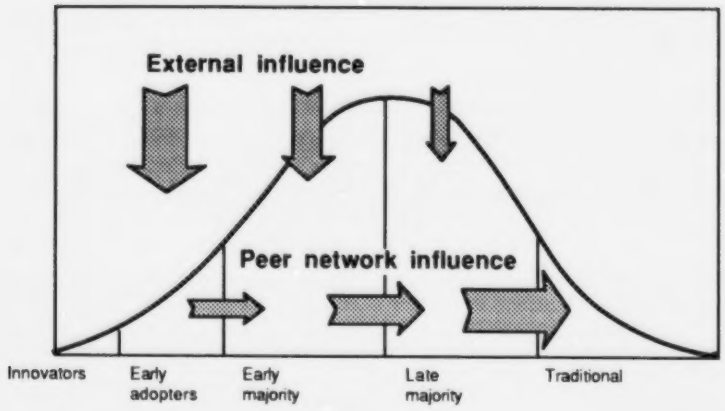

FIGURE 4. Distribution of individuals with respect to rate of adopting innovations. The relative importance of external and peer influences for each group is indicated by the thickness of the arrows.

3.2.3 Characteristics of Information

The study of the diffusion of innovations has revealed characteristics of information that influence its rate of application. The following summary is adapted from a review of Adaptive Environmental Assessment and Management (ESSA Ltd. 1982).

- Relative advantage

Relative advantage is the degree to which an innovation is more beneficial than the tool, method, or idea it replaces. Relative advantage is usually judged in economic terms (e.g., increased yields) but may also be measured in any other terms that reflect stated values and objectives (e.g., quality of public service).

Implication

Extension vehicles with an operational perspective are required.

- Complexity

Complexity is the relative ease with which an innovation can be understood and implemented. The electronic calculator, for example, is extremely simple to use and was adopted very rapidly.

Implication

Research results need to be synthesized and presented simply and clearly; an interpretive role is implied.

- Trialability

Trialabilty is the extent to which an innovation can be implemented a little at a time. No manager wants to risk too much on a new, untested approach. If the approach can be tested on a small scale, such as a few acres of a new genetic strain, then it is more likely to be considered on a broader scale and eventually adopted.

Implication

An institutional system that encourages small-scale experiments and trials by the user will promote adoption of new information. Demonstration sites and demonstration projects can enhance the apparent trialability of the innovation if they are readily accessible.

- Compatibility

Compatibility is the degree to which an innovation is consistent with the attitudes, values, beliefs, and needs of potential adopters. For example, it is difficult to adopt a policy of prescribed burning in the summer, because the policy conflicts with traditional views.

Implication

The innovation should be designed to be compatible with existing values and needs; hence, integration between researchers and users is very important. Extension vehicles should be designed to enhance the compatibility of the information. The whole extension program should be designed in a manner that is compatible with existing attitudes and values as far as possible.

- Observability

Observability is the ease with which an innovation or its effect can be seen. Tangible products, such as television sets, can be judged more readily than intangible ones, such as increased communication. Delays between experiment and result (such as those inherent in silvicultural treatments) also constitute a serious handicap to adoption.

Implication

Illustrations and demonstrations are needed as elements in the extension program. Results from past monitoring programs can serve as observable demonstrations (Pearce 1988). Continuation of monitoring is required to determine and communicate the effectiveness of applying the new knowledge in the field.

4 GUIDELINES FOR EXTENSION METHODS

4.1 Framework for Extension Vehicles

It is well known that different products are suitable for different audiences. A useful distinction between two major product types is provided by Nordansjö (1984). He specifies two streams of information flow: one for publications and the other for training. In this report, the distinction will be broadened to apply to documents on the one hand and personal contact vehicles on the other.

Another distinction involves user types. Four basic user types are identified for forestry extension: field, silviculture, management, and research.[1] The types of information required by these users include both scientific and applied, though field foresters have a much higher need for applied information and researchers for scientific, with silviculture somewhere between. A manager generally needs familiarity with both, with the relative mix dependent on his position in the infrastructure.

When the above distinctions are combined with the various purposes for extension vehicles presented in Figure 3, a basic framework for characterizing extension vehicles is generated (Figure 5). This framework distinguishes:

- two major vehicle types: documents and personal contact;

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[1] In British Columbia these user types are defined to include the following:

Field	Resource Assistants, Assistant Foresters
Silviculture	Resource Officers, District Silviculturists, Silviculture Co-ordinators, Silviculture Foresters
Management	District Managers, Administrative Foresters
Research	Headquarters, Regional, University, Private Researchers

- the nature of the information on a continuum from scientific to practical (to represent the needs of the user types); and
- the purpose of each vehicle within a diffusion process: familiarity, understanding, and application.

Extension vehicles are defined within this framework (Bunnell and Pearce 1988). Each has a general range and approximate boundaries such that each vehicle overlaps with others to a greater or lesser extent. With this framework, one can first identify the purpose of a variety of vehicles, and then determine what vehicles are required to fulfill the desired functions.

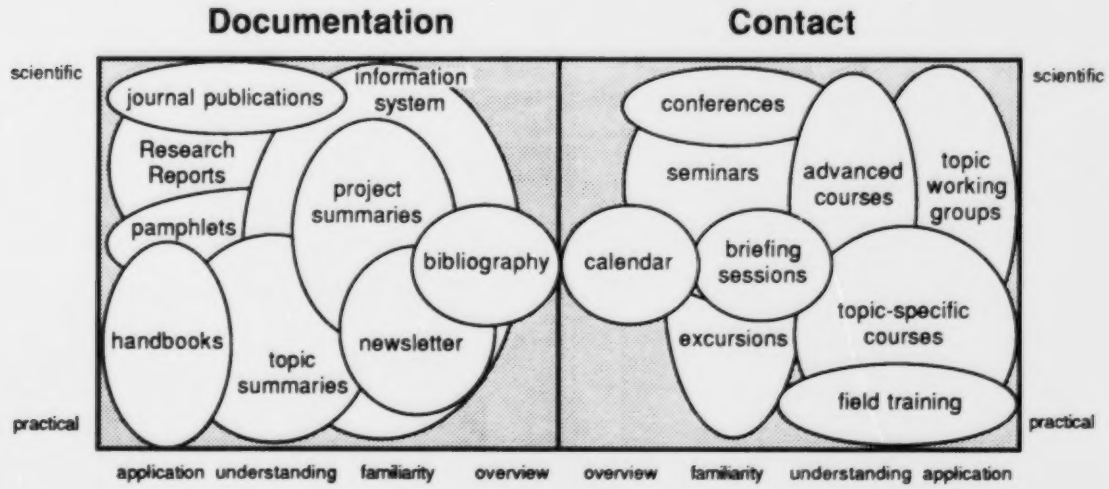

FIGURE 5. Framework for extension vehicles.

4.2 Communication Aids

Communication aids are distinguished from extension vehicles in that they affect the quality of delivery but do not replace delivery. For example, slides or overheads enhance a seminar or training session, but do not constitute the seminar or training. This is also true for videotapes and slide-tape programs. As physical entities they have limited impact, but incorporated into a briefing or training they effectively encapsulate and enliven information. Aids are not extension vehicles.

A few items tread the borderline between communication aids and extension vehicles. For example, pamphlets can be viewed as extremely short and illustration-rich publications, and they can be incorporated as an aid into briefing sessions and trainings.

Figure 6 shows the functional role of each aid type in the extension framework developed above. It is clear that some aid types, such as photos or drawings, slides or overheads, and field demonstrations can serve a wide range of functions. The design of any specific aid does, however, tune it to the intended application. Other aid types appear to have a narrow function. For example, posters, displays, and slide-tapes or videos largely provide an overview and familiarity. This does not mean that they have limited utility, because the overview function is necessary within a number of extension vehicles such as briefing sessions or training programs.

The suitability of a variety of aid types in both documentation and personal contact vehicles is summarized in Figures 7 and 8, respectively. In documents, illustrations serve as the primary communication aid. In Figure 7, four types of illustrations are identified: photographs, drawings, graphs, and technical diagrams. The border between the latter two is approximate; the intended distinction is the degree of technical complexity. Some diagram types are deemed unsuitable for specific documents for practical reasons. For example, from the user perspective photographs would be suitable in research memos, but from a production perspective they are impractical. Two elements of the documentation system, Information Systems and the Bibliography, differ from the rest in that they are computer-based. Communication aids would be used in the extension vehicles for familiarizing users with the systems.

Communication aids suitable for personal contact extension vehicles (Figure 8) include simple aids like flip charts, slides and overheads, and handouts, as well as production-intensive aids such as slide-tape programs, videotapes, workbooks, and instructors manuals. Demonstration sites are classified as a communication aid in this report in that they serve to enhance the delivery of other extension vehicles (seminars, training sessions) rather than serving as a stand-alone product.

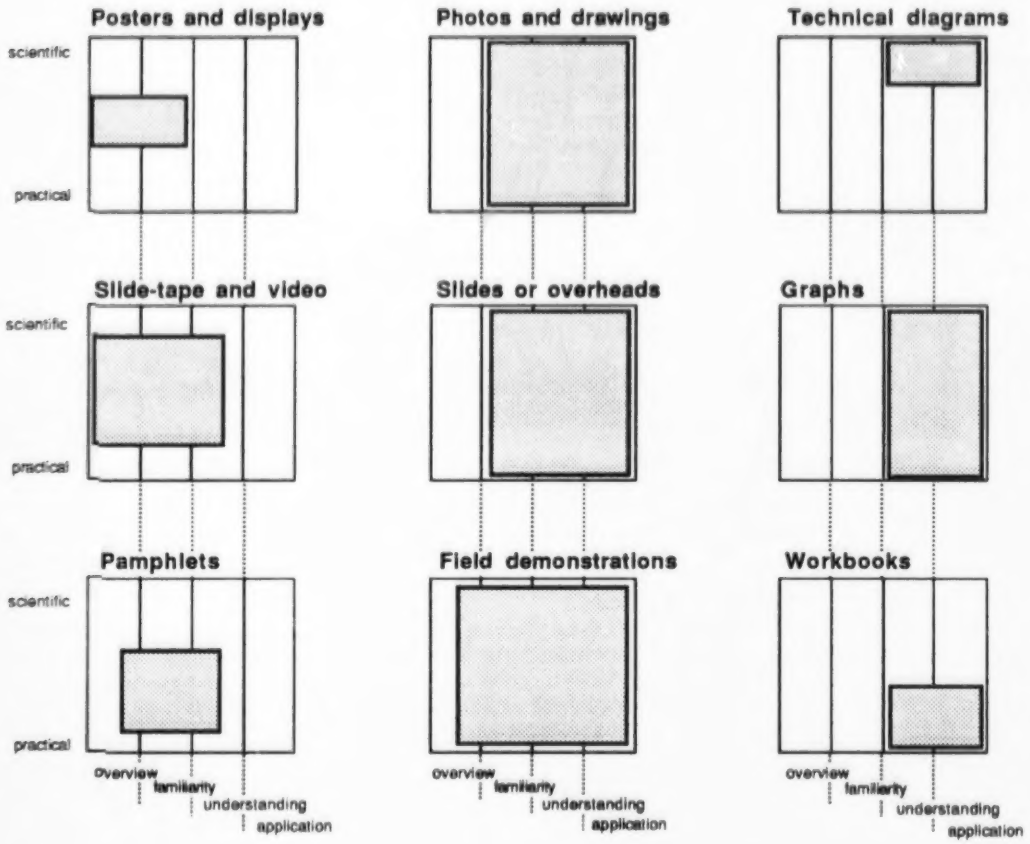

FIGURE 6. Functional roles of communication aids.

It is clear from Figure 8 that each vehicle has a different set of suitable communication aids. Furthermore, each aid type is suitable or very suitable for at least one extension vehicle, consequently none should be totally ignored. Other factors than those included in this chart influence the choice of the communication aid. For example, although slide-tapes and videos are not high in the "suitability evaluation" given here, they are the preferred format if action scenes need to be shown without the benefit

or real-life observations, or if information needs to be condensed into a very short time, or if there is uncertainty with respect to the interpretation that can be provided by the person using the aid. In general, aids that allow passive viewing are less useful than those that encourage participation.

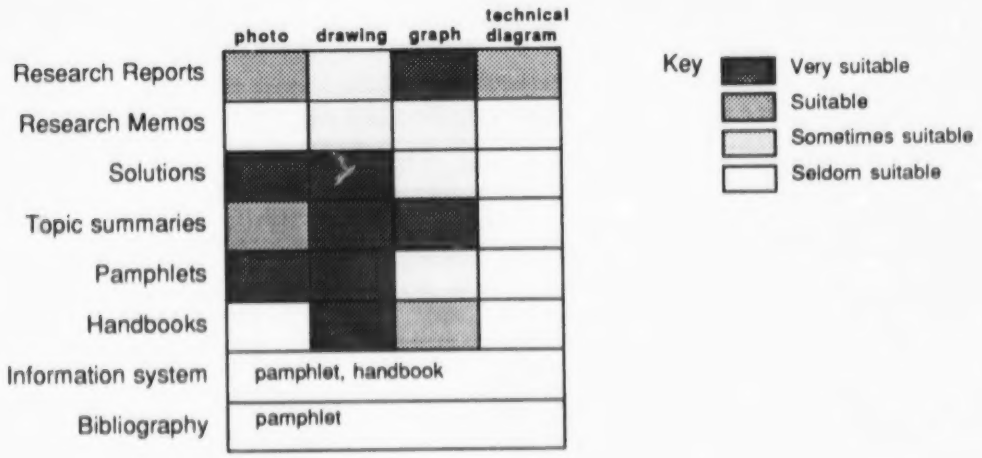

FIGURE 7. Communication aids suitable for documentation.

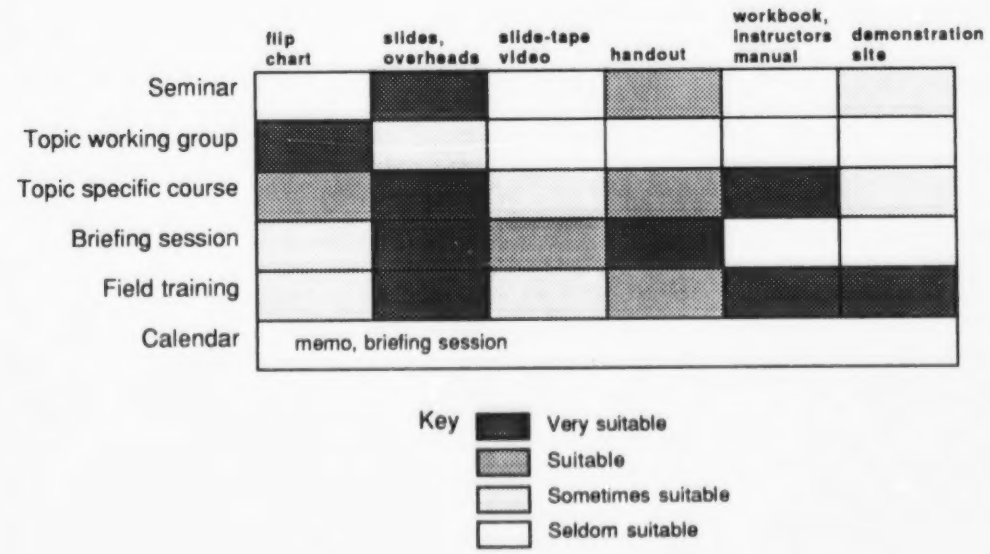

FIGURE 8. Communication aids suitable for personal contact.

4.3 Expertise

A broad array of expertise is required to develop and deliver an extension program. Since few individuals can be expected to possess the entire range of knowledge and skills, it is useful to distinguish a few basic roles, and to clarify the expertise required for each. The basic roles are information synthesis, design of the extension vehicle, production, and delivery. These roles and their respective expertise requirements are presented in Table 1.

TABLE 1. Roles and expertise required in an extension program

Role	Expertise required
Synthesis	Content
Design	Content, audience, design methods
Production	Production methods
Delivery	Content, audience, personality, training methods

People responsible for synthesizing the content for the extension vehicles need to have both a good conceptual understanding, and access to a broad base of information on the subject area. Furthermore, they should be capable of synthetic thinking so that the compilation of information does not become an amassment of details.

People responsible for design need a basic understanding of the content, to avoid the danger of misrepresentation. Furthermore, they need a basic understanding of the intended audience to target the document, visual aid, or training appropriately. Finally they need to be fluent in design methods, and have the skill to design material that is easy to assimilate.

Production of extension vehicles requires expertise related to the vehicle type. For documents this requires technical editing, illustrating, drafting, layout, and production expertise. Documents are also used in training programs, implying the above expertise. Communication aids also have expertise requirements, often specific to the aid type (e.g., overheads, video). In general graphic design, illustration, photography, composition, editing, and production skills are needed.

Delivery of documents depends on institutional systems, such as mailing/distribution services or library facilities, and requires organizational skills. On the other hand, the successful delivery of personal contact vehicles (seminars, briefings, courses, and field trainings) is sensitive to the expertise of the person in this role. The trainer needs to have a broad understanding of the topic and an understanding of, and empathy for, the audience. His personal approach – that is, his ability to communicate his respect for the audience, his ability to listen and respond to their explicit and implicit concerns, and his enthusiasm for the topic and process – is critically important. Some of this can be learned; some is inherent in personality.

For the contact to be successful, the audience must also respect the trainer. In many circumstances, individuals develop a reputation, so the audience is inclined to respect them. In other circumstances, their position in the organization can set the stage for respect (e.g., a senior level individual may be most suitable for addressing a management group). Where a training session is sufficiently long (usually more than a day), the respect of the audience for the trainer can be developed during the session. The trainer should be familiar with training methods, either through his own experience or through formal coaching.

5 CONCLUSION

As pointed out in the introduction to this paper, understanding is fundamental to wise resource management. Extension programs provide understanding and hence support management. The design of a good extension program depends largely on the intentions and commitment of the individuals involved. Deeply committed people find ways to make things work. The guidelines in this paper are

intended to help those people by providing a framework for organizing their work, and by bringing together information from a number of relevant sources.

In summary, the major conclusions for developing good extension programs and methods are:

1. People – trained, knowledgeable, and empathetic – are the prime ingredient in developing and maintaining an effective extension program. This is shown both by the overview of successful extension programs, and by the basic principles of learning and disseminating information. Personal contact, interaction, interpretation, and discussion are fundamental to the way knowledge is shared and appropriate actions result.

2. Institutional and administrative support is needed for the people who are engaged in extension activities. As policy evolves to acknowledge the significance of this activity along with the more traditionally supported activities of research and operations, the institutional reward and acknowledgement system will develop. Again, in the early stages it depends on people: people in administrative positions with vision and the willingness to take personal risks in encouraging the system to change.

3. Support materials in the form of information systems, documentation, training materials, and communication aids are the basic tools for the people involved in the extension program. As highly skilled workmen need quality tools, extension personnel need communication tools especially designed for the knowledge they convey.

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